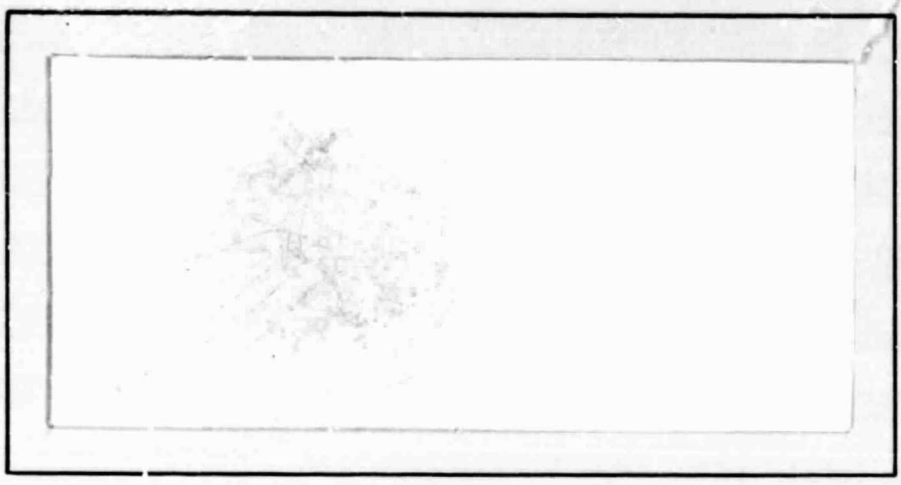

SCIENCE APPLICATIONS INCORPORATED

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FINAL REPORT
DESIGN, FABRICATION AND
TEST OF LAST CUT FOLLOWER

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NAS8-33700

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OPTICAL CUT-FOLLOWER

The Optical Cut-Follower, Figures 1 and 2, was developed by Science Applications, Inc., of Huntsville, Alabama, (NAS8-33700) with technical support from Adjunct Systems, Inc. It operates on a triangulation concept in the following manner. An objective lens images the last cut onto a focal plane where a narrow slit is affixed to a photo detector and placed to limit the field of view to a small slice across (transverse to) the last cut and directly above the device. The field is as close to the shearer's cutting drum as practical.

An incandescent light beam (from the miner's lamp) is reflected from a rotating mirror mounted 15.24 cm from, but at an equal elevation to, the principal plane of the objective lens. The light beam is reflected from the mirror toward the roof such that the light beam scans along the surface of the last cut as the mirror rotates. When the beam falls within the field of view, the photodetector responds with an output electrical pulse.

The rotating mirror is equipped with an incremental optical shaft rotation encoder, designed to produce 2000 pulses per revolution. At a present point in the mirror's rotation, a counter is activated (see Figure 3). The counter continues recording pulses until a pulse is received from the photodetector indicating the instant the light beam has crossed the field of view. Trigonometric relationships allow the computation of the last cut height above the objective lens. This distance, added to a constant associated with the offset in vertical and horizontal between the objective and the center of the cutting drum, provides the height to the last cut.

Acceptance testing of the Science Applications, Inc. mine permissible Optical Cut-Follower was successfully completed on the MSFC laboratory simulator. A measuring accuracy of $\pm$ 1/16-inch was noted. Testing is now in progress at the Bruceton Mock Longwall Facility using the Joy Manufacturing Company's shearer. Preliminary results are included in this report, based on the calibration curve of Figure 4.

The instrument, weighing 45 lbs., is housed in an explosive-proof box, measuring 6"x6"x10", and mechanically and electrically compatible with the mounting connections used for the Radar Cut-Follower.

The instrument has also been tested at the Bruceton mock longwall face, mounted on the Joy longwall shearer.

The results of the Bruceton tests are shown on Figures 5 and 6 depicting the roof profile measured while the Joy shearer was tramming (Figure 5) and while cutting (Figure 6). The curves are displayed with an accompanying acoustic measurement (offset) for comparison. It may be noted that the optical curve follows the acoustic curve with a surprising degree of accuracy. Also, some dust buildup was observed on the surface of the optical lens during cutting (Figure 6). Means of resolving this problem are under investigation. Figures 7 and 8 show photographs of the system mounted on the shearer in Bruceton.

A complete reproducible set of mechanical drawings and electrical schematics have been delivered to NASA/MSFC.

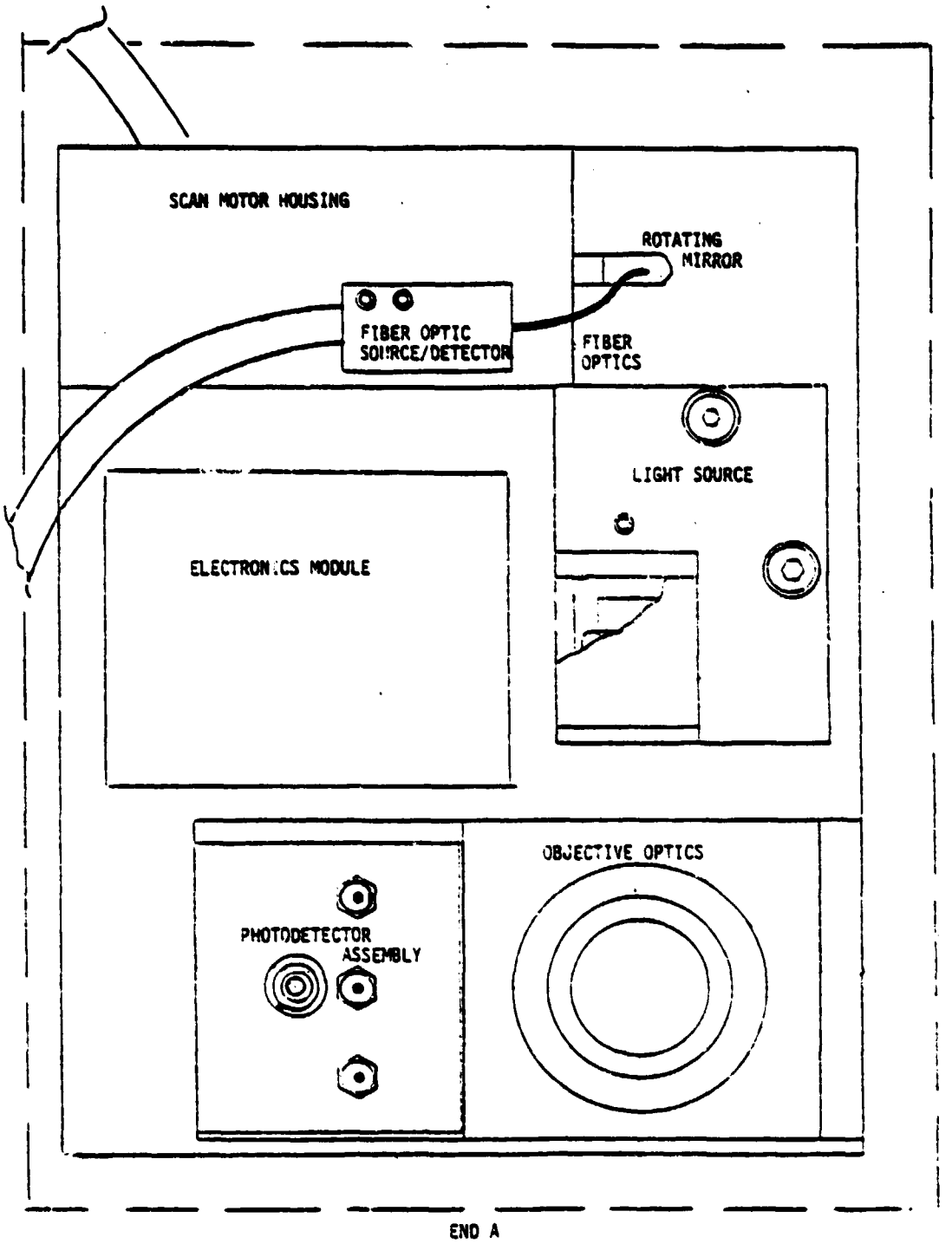

Figure 1. Top View Optical Last Cut-Follower

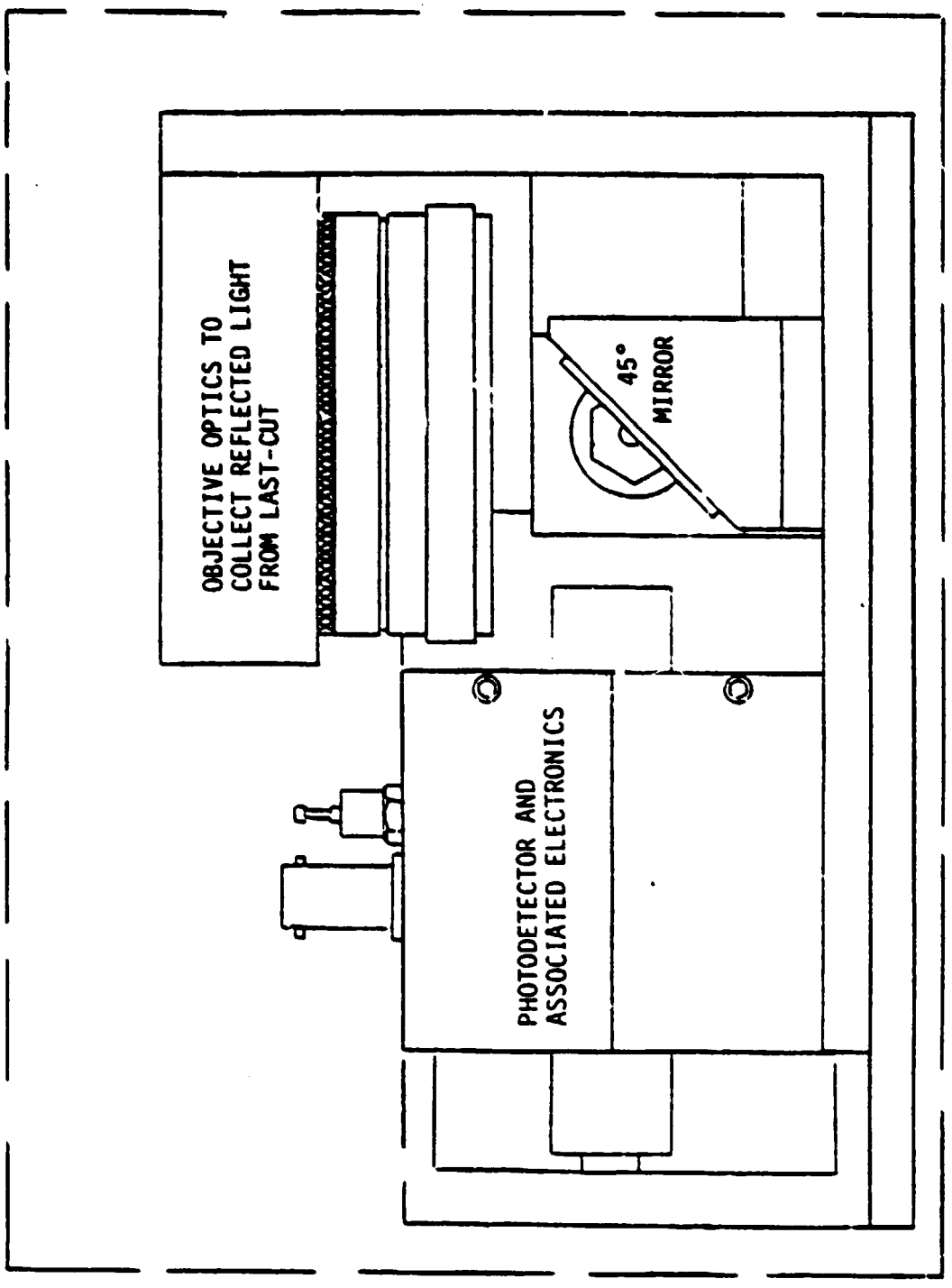

Figure 2. Optical Last Cut-Follower - Side View

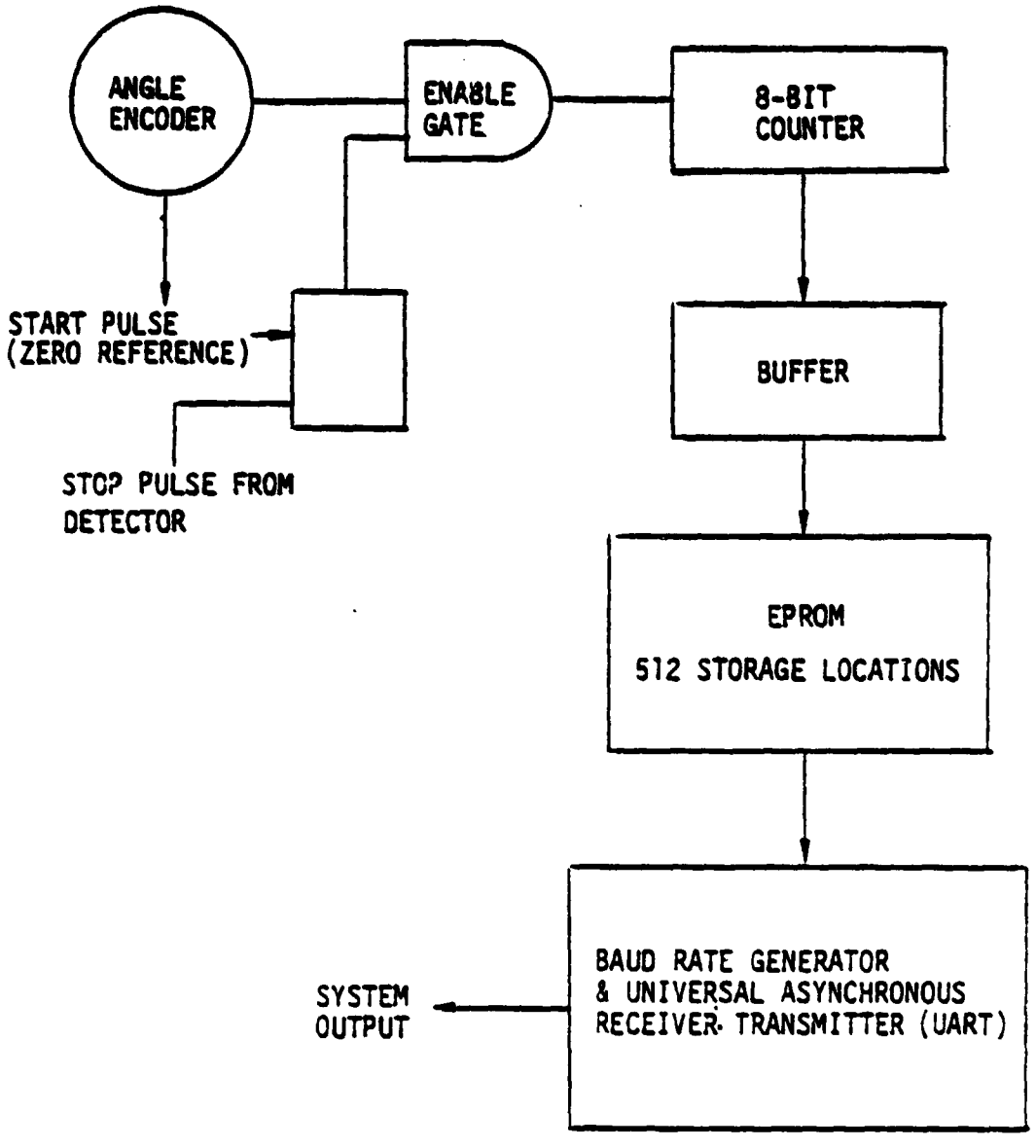

Figure 3. Functional Schematic of Counting, Processing and Transmitting Electronics

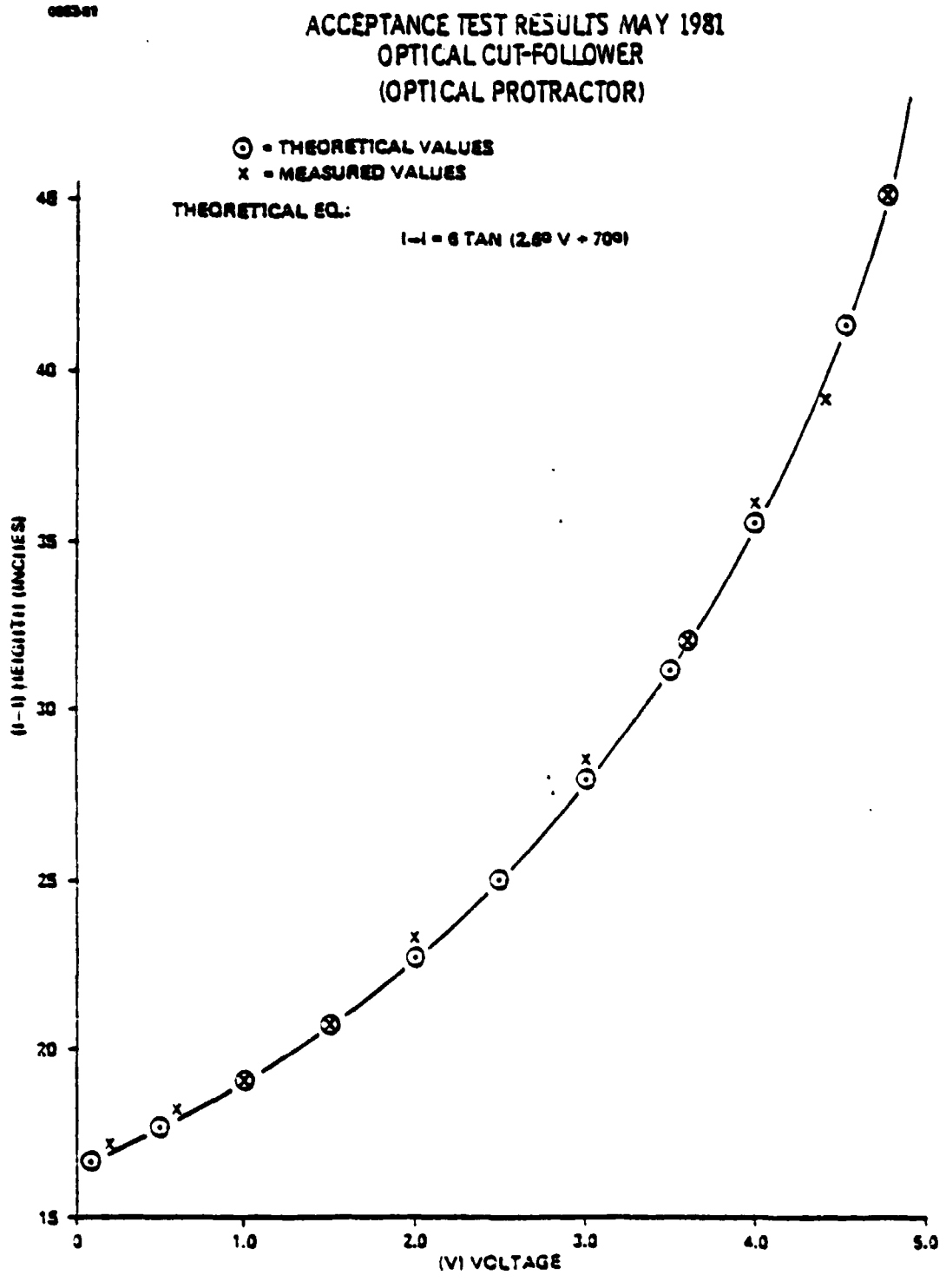

Figure 4. Acceptance Testing

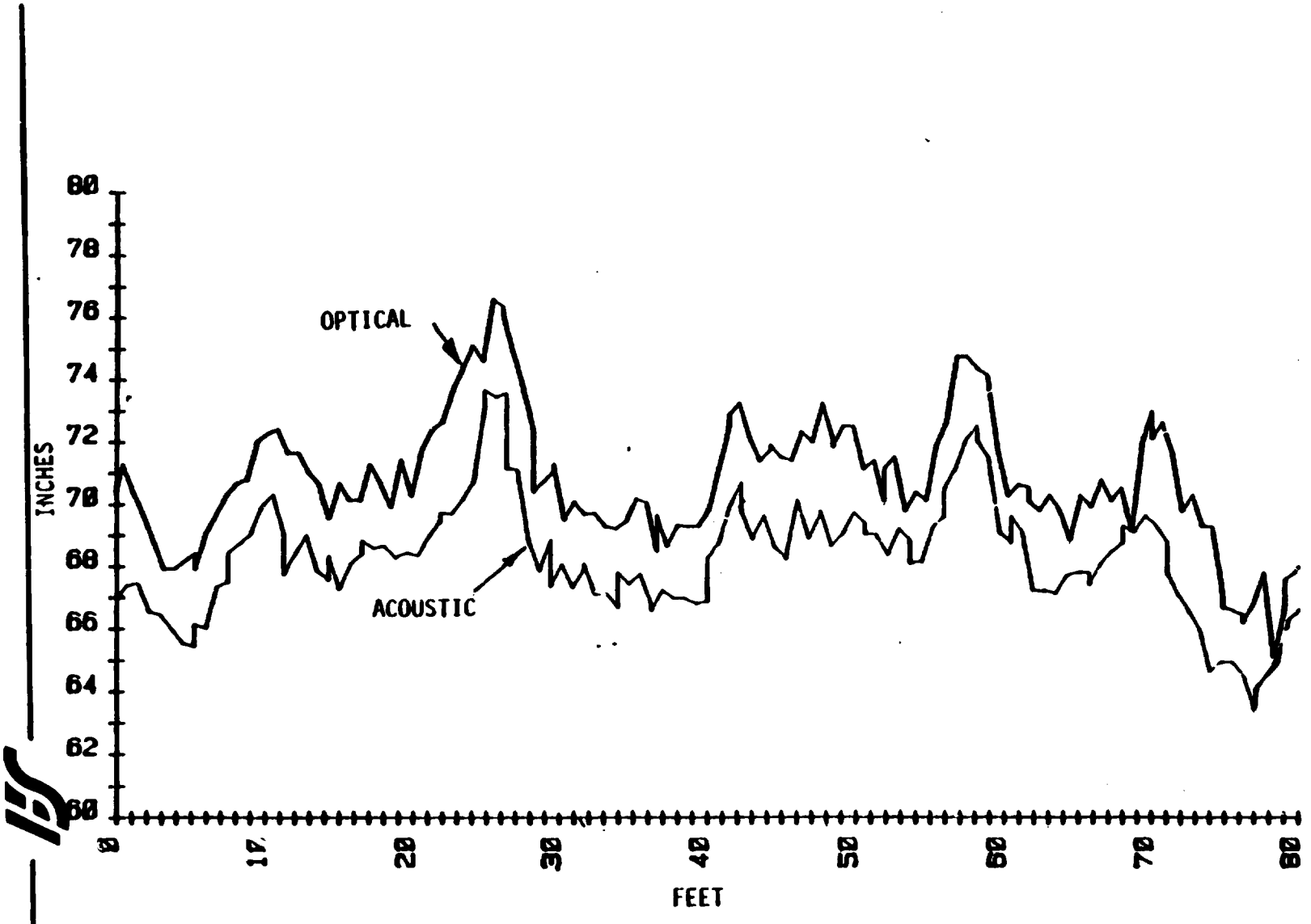

Figure 5. Comparison of Optical and Acoustic Last Cut-Followers-Tramming Offset Adjustable During Data Reduction Process

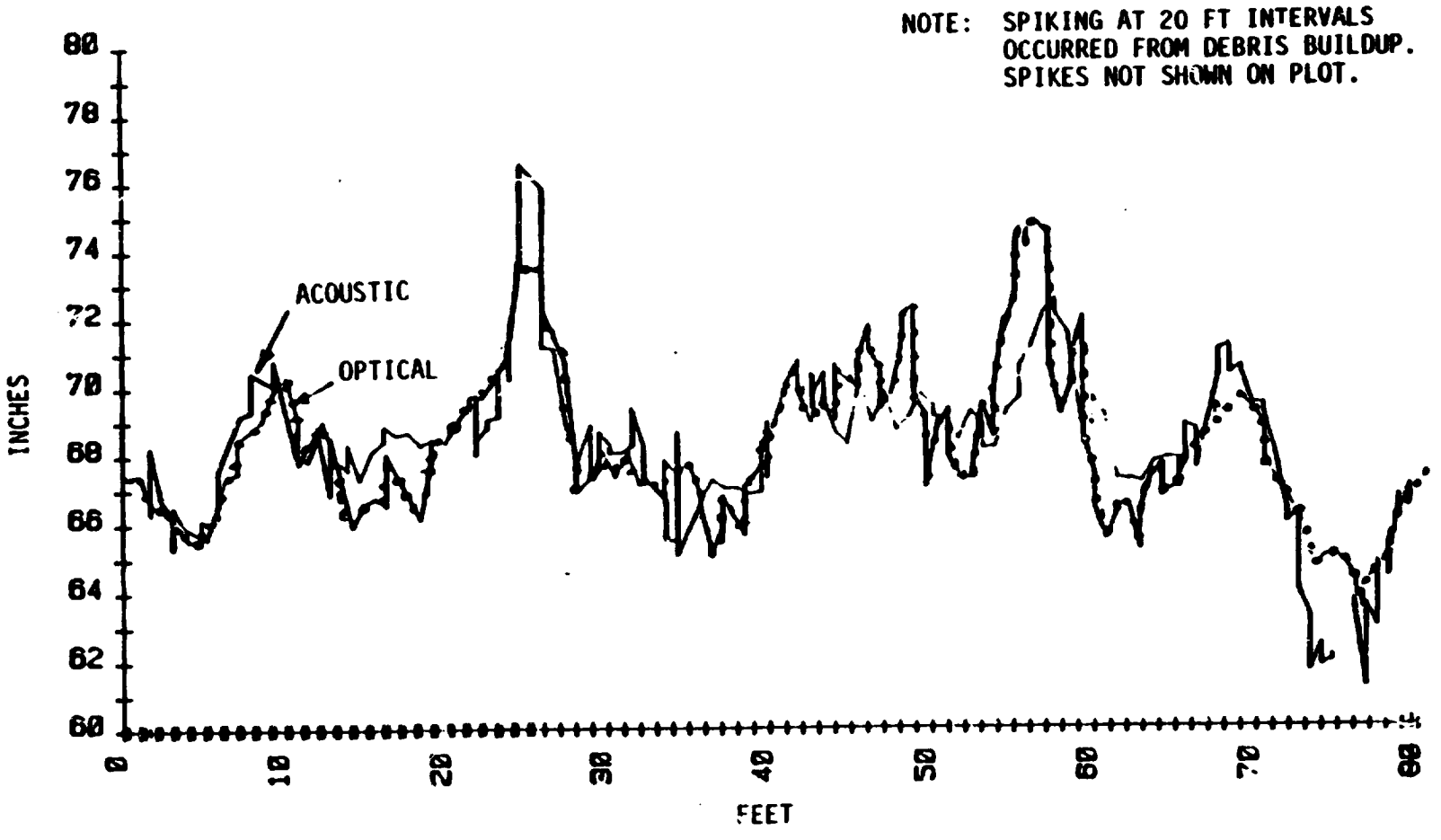

Figure 6. Comparison of Optical and Acoustic Last Cut-Followers Data-Cutting. The Optical Window was Manually Brushed Clean Every 20 Feet.

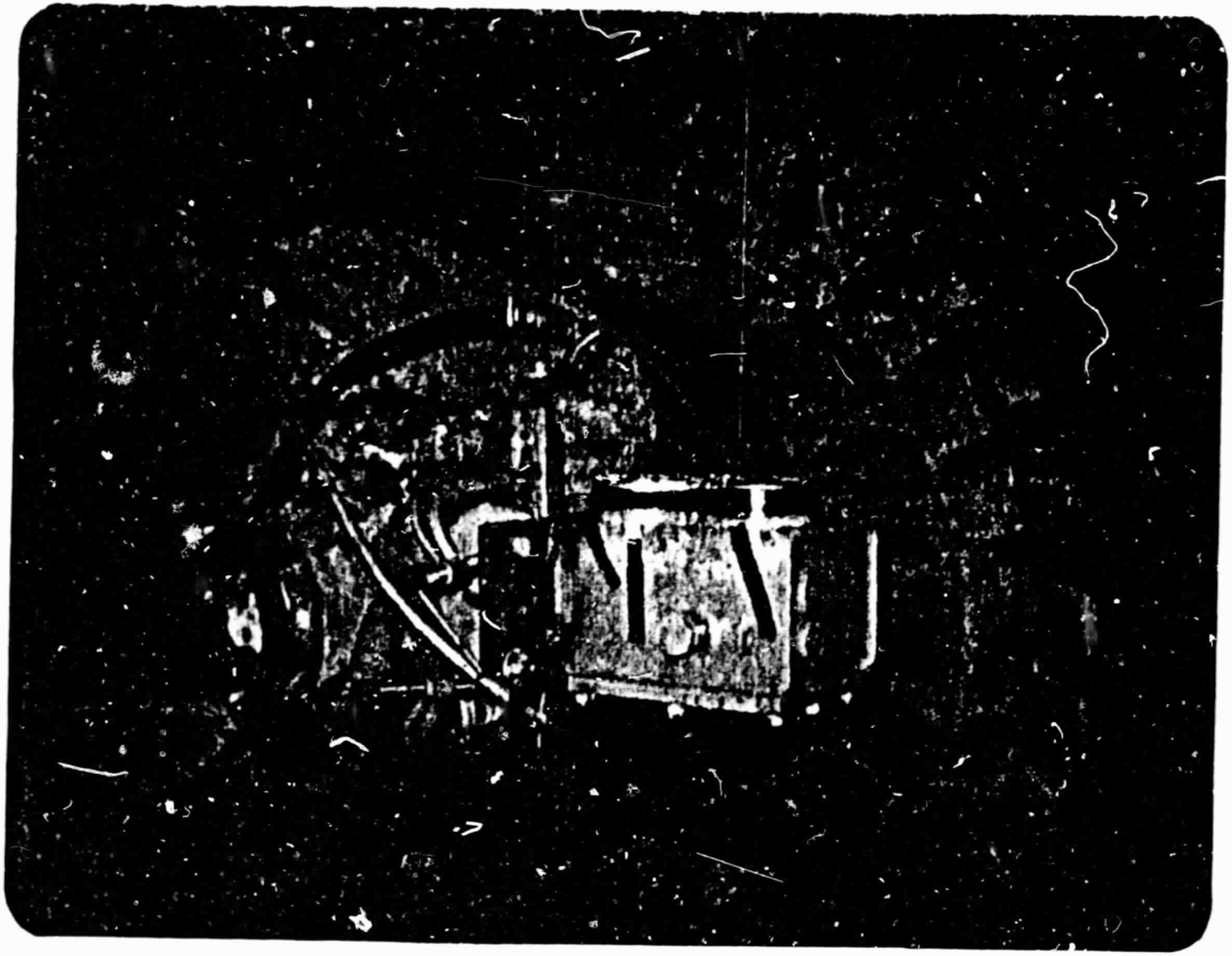

Figure 7. Optical Cut-Follower Mounted on Joy Shearer at Bruceton Test Facility

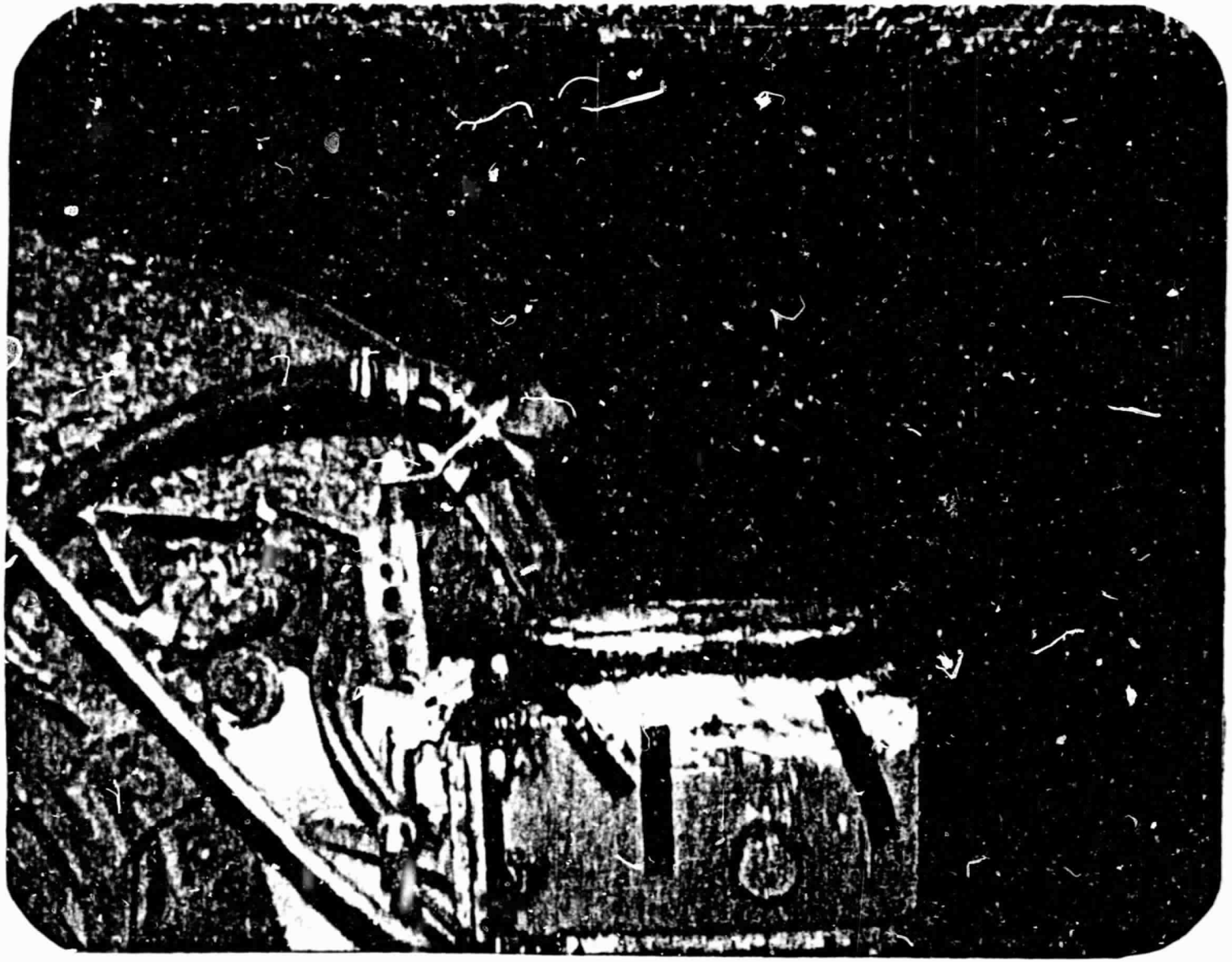

Figure 8. Optical Cut-Follower Mounted on Joy Shearer Showing Water Spray at Bruceton Test Facility